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CIRCULAR NO. 142

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# SOLAR ECLIPSES, 1981–1990

by

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## SOLAR ECLIPSES, 1981 – 1990

At the request of Commission 12a of the International Astronomical Union, the American Nautical Almanac Office agreed to publish advance information on solar eclipses.

This *Circular* gives the results of the definitive calculations for all solar eclipses from 1981 through 1990.

The arguments are given in Ephemeris Time (E. T.), and the longitudes are referred to the "Ephemeris Meridian", (see *Explanatory Supplement to the Astronomical Ephemeris and the American Ephemeris and Nautical Almanac*).

Once the value of $\Delta T$ is known, the accurate position of the track may be obtained in the following manner.

Change all time-arguments into Universal Time by setting,

$$E.T. = U.T. + \Delta T.$$

Leave latitudes unchanged, and refer the longitudes to the meridian of Greenwich by applying $-1.002738\ \Delta T$ as a correction to the tabulated longitudes.

East longitudes are negative.

## ANNULAR ECLIPSE OF 1981 FEBRUARY 4–5

### Central Line

| Ephemeris Time | Latitude | Ephemeris Longitude | Duration | Width of Path | Altitude of Sun |
|---|---|---|---|---|---|
| h m | ° ′ | ° ′ | m s | *mi* | ° |
| Limit | −38 55 | −131 32 | . .. . | ... | .. |
| 20 35 | 41 13.1 | 139 32.6 | 1 07.5 | 51 | 7 |
| 40 | 44 31.7 | 152 31.2 | 1 01.2 | 42 | 18 |
| 45 | 46 08.4 | 160 12.4 | 0 57.2 | 36 | 24 |
| 50 | 47 11.5 | 166 19.5 | 0 53.8 | 32 | 29 |
| 55 | 47 54.8 | 171 35.6 | 0 50.9 | 29 | 33 |
| 21 00 | −48 24.4 | −176 18.4 | 0 48.2 | 27 | 37 |
| 05 | 48 43.2 | +179 23.1 | 0 45.7 | 25 | 40 |
| 10 | 48 53.4 | 175 23.7 | 0 43.5 | 23 | 43 |
| 15 | 48 56.3 | 171 39.7 | 0 41.4 | 21 | 46 |
| 20 | 48 52.8 | 168 08.9 | 0 39.5 | 20 | 48 |
| 25 | 48 43.8 | 164 49.4 | 0 37.7 | 19 | 51 |
| 21 30 | −48 29.8 | +161 39.9 | 0 36.1 | 17 | 53 |
| 35 | 48 11.2 | 158 39.3 | 0 34.7 | 17 | 55 |
| 40 | 47 48.5 | 155 46.7 | 0 33.4 | 16 | 56 |
| 45 | 47 22.1 | 153 01.4 | 0 32.3 | 15 | 58 |
| 50 | 46 52.1 | 150 22.6 | 0 31.3 | 15 | 59 |
| 55 | 46 18.9 | 147 49.7 | 0 30.5 | 14 | 60 |
| 22 00 | −45 42.6 | +145 22.1 | 0 29.9 | 14 | 60 |
| 05 | 45 03.3 | 142 59.2 | 0 29.4 | 13 | 61 |
| 10 | 44 21.3 | 140 40.5 | 0 29.1 | 13 | 61 |
| 15 | 43 36.6 | 138 25.4 | 0 29.0 | 13 | 61 |
| 20 | 42 49.3 | 136 13.3 | 0 29.1 | 13 | 60 |
| 25 | 41 59.4 | 134 03.7 | 0 29.3 | 14 | 60 |
| 22 30 | −41 07.0 | +131 56.0 | 0 29.7 | 14 | 59 |
| 35 | 40 12.0 | 129 49.5 | 0 30.2 | 15 | 57 |
| 40 | 39 14.4 | 127 43.5 | 0 31.0 | 16 | 56 |
| 45 | 38 14.2 | 125 37.3 | 0 31.9 | 16 | 54 |
| 50 | 37 11.1 | 123 30.1 | 0 33.0 | 17 | 52 |
| 55 | 36 05.1 | 121 20.7 | 0 34.2 | 18 | 50 |
| 23 00 | −34 55.8 | +119 08.1 | 0 35.7 | 19 | 48 |
| 05 | 33 42.9 | 116 50.8 | 0 37.3 | 21 | 45 |
| 10 | 32 25.9 | 114 26.8 | 0 39.2 | 22 | 42 |
| 15 | 31 04.1 | 111 53.7 | 0 41.2 | 25 | 39 |
| 20 | 29 36.5 | 109 07.8 | 0 43.5 | 26 | 36 |
| 25 | 28 01.5 | 106 03.6 | 0 46.1 | 29 | 32 |
| 23 30 | −26 16.3 | +102 32.0 | 0 49.0 | 32 | 28 |
| 35 | 24 15.4 | 98 14.8 | 0 52.5 | 36 | 23 |
| 40 | 21 44.6 | 92 23.8 | 0 57.0 | 41 | 16 |
| Limit | −16 40 | + 77 45 | . .. . | ... | .. |

Geocentric conjunction will occur in right ascension $21^h\ 13^m\ 53^s.93$, at E. T. $4^d\ 21^h\ 58^m\ 28^s.0$, the declination of the Sun being −16° 02′ 11″.5.

The path of the annular phase will begin in the Great Australian Bight, will cross Tasmania, and will end in the South Pacific Ocean off the coast of Peru. The partial phase will be visible in Australia except the western part, New Zealand, the South Pacific Ocean, most of Antarctica, and western South America.

## TOTAL ECLIPSE OF 1981 JULY 31

### Central Line

| Ephemeris Time | Latitude | Ephemeris Longitude | Duration | Width of Path | Altitude of Sun |
|---|---|---|---|---|---|
| h m | ° | ° ′ | m s | *mi* | ° |
| Limit | +42 01 | − 39 34 | . .. . | ... | .. |
| 2 20 | 45 24.5 | 49 31.0 | 0 50.3 | 44 | 8 |
| 25 | 49 06.5 | 61 23.2 | 1 04.0 | 52 | 18 |
| 2 30 | +51 11.3 | − 69 06.9 | 1 13.1 | 55 | 24 |
| 35 | 52 39.5 | 75 30.0 | 1 20.6 | 58 | 28 |
| 40 | 53 45.5 | 81 10.2 | 1 27.0 | 60 | 32 |
| 45 | 54 35.3 | 86 22.6 | 1 32.7 | 62 | 36 |
| 50 | 55 12.3 | 91 15.2 | 1 37.8 | 63 | 39 |
| 55 | 55 38.4 | 95 52.2 | 1 42.3 | 64 | 41 |
| 3 00 | +55 55.3 | −100 16.3 | 1 46.4 | 65 | 44 |
| 05 | 56 03.9 | 104 29.2 | 1 49.9 | 66 | 46 |
| 10 | 56 05.0 | 108 31.8 | 1 53.0 | 67 | 48 |
| 15 | 55 59.4 | 112 25.0 | 1 55.6 | 67 | 49 |
| 20 | 55 47.5 | 116 09.3 | 1 57.8 | 67 | 51 |
| 25 | 55 29.8 | 119 45.1 | 1 59.6 | 68 | 52 |
| 3 30 | +55 06.8 | −123 13.0 | 2 01.0 | 68 | 53 |
| 35 | 54 38.9 | 126 33.3 | 2 01.9 | 69 | 54 |
| 40 | 54 06.2 | 129 46.6 | 2 02.4 | 69 | 54 |
| 45 | 53 29.2 | 132 53.3 | 2 02.5 | 69 | 54 |
| 50 | 52 47.9 | 135 53.9 | 2 02.1 | 69 | 54 |
| 55 | 52 02.7 | 138 49.0 | 2 01.4 | 69 | 54 |
| 4 00 | +51 13.5 | −141 39.4 | 2 00.3 | 69 | 54 |
| 05 | 50 20.7 | 144 25.6 | 1 58.7 | 69 | 53 |
| 10 | 49 24.0 | 147 08.5 | 1 56.7 | 69 | 52 |
| 15 | 48 23.7 | 149 49.0 | 1 54.4 | 68 | 50 |
| 20 | 47 19.6 | 152 28.0 | 1 51.6 | 68 | 49 |
| 25 | 46 11.5 | 155 06.6 | 1 48.5 | 67 | 47 |
| 4 30 | +44 59.3 | −157 46.2 | 1 44.9 | 67 | 45 |
| 35 | 43 42.5 | 160 28.3 | 1 41.0 | 66 | 43 |
| 40 | 42 20.7 | 163 15.0 | 1 36.6 | 65 | 40 |
| 45 | 40 53.1 | 166 08.9 | 1 31.7 | 63 | 38 |
| 50 | 39 18.6 | 169 13.7 | 1 26.3 | 62 | 34 |
| 55 | 37 35.2 | 172 35.0 | 1 20.3 | 59 | 31 |
| 5 00 | +35 39.9 | −176 22.2 | 1 13.5 | 57 | 27 |
| 05 | 33 26.3 | +179 06.6 | 1 05.6 | 53 | 22 |
| 10 | 30 37.7 | 173 02.5 | 0 55.7 | 48 | 15 |
| Limit | +24 52 | +158 17 | . .. . | ... | .. |

Geocentric conjunction will occur in right ascension $8^h\ 41^m\ 01\overset{s}{.}58$, at E. T. $31^d\ 03^h\ 36^m\ 24\overset{s}{.}7$, the declination of the Sun being +18° 18′ 31″.2.

The path of the total phase will begin in the eastern part of the Black Sea, will cross the central part of Asia, and will end in the Pacific Ocean north of the Hawaiian Islands. The partial phase will be visible in eastern Europe, Asia except the extreme southern part, the North Pacific Ocean, the northwestern part of North America, and the arctic regions.

## PARTIAL ECLIPSE OF 1982 JANUARY 25

Geocentric conjunction will occur in right ascension $20^h\ 28^m\ 51\overset{s}{.}80$, at E. T. $25^d\ 04^h\ 21^m\ 53\overset{s}{.}9$, the declination of the Sun being $-19°\ 02'\ 57\overset{''}{.}2$. The greatest eclipse will have a magnitude of 0.566 at longitude $+91°\ 45'$, latitude $-69°\ 17'$.

The eclipse will be visible in most of Antarctica, New Zealand except the northern part, the southern part of the South Pacific Ocean, and the southern part of the Indian Ocean.

## PARTIAL ECLIPSE OF 1982 JUNE 21

Geocentric conjunction will occur in right ascension $5^h\ 59^m\ 02\overset{s}{.}51$, at E. T. $21^d\ 11^h\ 52^m\ 24\overset{s}{.}7$, the declination of the Sun being $+23°\ 26'\ 26\overset{''}{.}0$. The greatest eclipse will have a magnitude of 0.617 at longitude $-12°\ 58'$, latitude $-65°\ 57'$.

The eclipse will be visible in the extreme southern part of Africa, the southern part of the South Atlantic Ocean, and the southern part of the Indian Ocean.

## PARTIAL ECLIPSE OF 1982 JULY 20

Geocentric conjunction will occur in right ascension $7^h\ 59^m\ 07\overset{s}{.}56$, at E. T. $20^d\ 18^h\ 30^m\ 55\overset{s}{.}2$, the declination of the Sun being $+20°\ 37'\ 20\overset{''}{.}7$. The greatest eclipse will have a magnitude of 0.465 at longitude $-64°\ 05'$, latitude $+68°\ 36'$.

The eclipse will be visible in the extreme northern part of Asia, the nothwestern part of Europe, the northwestern part of North America, Greenland, Iceland, and the arctic regions.

## PARTIAL ECLIPSE OF 1982 DECEMBER 15

Geocentric conjunction will occur in right ascension $17^h\ 29^m\ 47\overset{s}{.}49$, at E. T. $15^d\ 09^h\ 11^m\ 47\overset{s}{.}9$, the declination of the Sun being $-23°\ 15'\ 34\overset{''}{.}1$. The greatest eclipse will have a magnitude of 0.736 at longitude $-56°\ 39'$, latitude $+65°\ 17'$.

The eclipse will be visible in Europe except the extreme northern part, the western half of Asia, and the extreme northeastern part of Africa.

## TOTAL ECLIPSE OF 1983 JUNE 11

### Central Line

| Ephemeris Time | Latitude | Ephemeris Longitude | Duration | Width of Path | Altitude of Sun |
|---|---|---|---|---|---|
| h m | ° ′ | ° ′ | m s | *mi* | ° |
| Limit | -36 13 | - 59 57 | • •• • | ••• | •• |
| 3 15 | 30 10.8 | 72 09.3 | 2 38.2 | 90 | 12 |
| 20 | 26 10.1 | 79 12.2 | 2 59.6 | 94 | 21 |
| 25 | 23 23.8 | 83 44.4 | 3 16.0 | 98 | 26 |
| 3 30 | -21 10.5 | - 87 14.6 | 3 30.0 | 101 | 31 |
| 35 | 19 17.4 | 90 09.4 | 3 42.6 | 104 | 35 |
| 40 | 17 38.5 | 92 41.0 | 3 54.1 | 106 | 39 |
| 45 | 16 10.4 | 94 56.3 | 4 04.6 | 109 | 42 |
| 50 | 14 51.0 | 96 59.6 | 4 14.4 | 110 | 45 |
| 55 | 13 39.0 | 98 53.8 | 4 23.4 | 113 | 47 |
| 4 00 | -12 33.2 | -100 40.9 | 4 31.7 | 114 | 50 |
| 05 | 11 33.0 | 102 22.4 | 4 39.2 | 117 | 52 |
| 10 | 10 37.9 | 103 59.6 | 4 46.0 | 118 | 54 |
| 15 | 9 47.4 | 105 33.4 | 4 52.1 | 120 | 56 |
| 20 | 9 01.1 | 107 04.6 | 4 57.3 | 120 | 57 |
| 25 | 8 18.9 | 108 33.9 | 5 01.8 | 122 | 58 |
| 4 30 | - 7 40.6 | -110 01.9 | 5 05.4 | 124 | 59 |
| 35 | 7 06.0 | 111 29.0 | 5 08.1 | 124 | 60 |
| 40 | 6 35.0 | 112 55.9 | 5 10.0 | 125 | 60 |
| 45 | 6 07.7 | 114 22.8 | 5 10.9 | 126 | 60 |
| 50 | 5 43.9 | 115 50.4 | 5 10.9 | 126 | 60 |
| 55 | 5 23.6 | 117 18.9 | 5 09.9 | 126 | 59 |
| 5 00 | - 5 07.0 | -118 48.9 | 5 08.0 | 126 | 59 |
| 05 | 4 54.2 | 120 20.9 | 5 05.1 | 126 | 58 |
| 10 | 4 45.2 | 121 55.4 | 5 01.3 | 125 | 56 |
| 15 | 4 40.2 | 123 33.0 | 4 56.5 | 124 | 55 |
| 20 | 4 39.5 | 125 14.4 | 4 50.8 | 124 | 53 |
| 25 | 4 43.4 | 127 00.4 | 4 44.1 | 122 | 51 |
| 5 30 | - 4 52.3 | -128 52.0 | 4 36.5 | 120 | 48 |
| 35 | 5 06.7 | 130 50.5 | 4 28.0 | 118 | 46 |
| 40 | 5 27.4 | 132 57.5 | 4 18.5 | 117 | 43 |
| 45 | 5 55.5 | 135 15.3 | 4 08.0 | 113 | 40 |
| 50 | 6 32.3 | 137 47.2 | 3 56.6 | 111 | 37 |
| 55 | 7 20.2 | 140 38.1 | 3 44.0 | 108 | 33 |
| 6 00 | - 8 23.1 | -143 56.6 | 3 29.9 | 105 | 28 |
| 05 | 9 48.4 | 147 59.1 | 3 13.9 | 101 | 23 |
| 10 | 11 55.4 | 153 28.8 | 2 54.3 | 96 | 16 |
| 15 | 17 52.6 | 167 37.1 | 2 15.0 | 85 | 1 |
| Limit | -18 05 | -168 07 | • •• • | ••• | •• |

Geocentric conjunction will occur in right ascension $5^h\ 15^m\ 13^s.49$, at E. T. $11^d\ 04^h\ 34^m\ 17^s.4$, the declination of the Sun being +23° 02′ 33″.1.

The path of the total phase will begin in the southern part of the Indian Ocean, will cross Indonesia, and will end in the Pacific Ocean between the New Hebrides and the Loyalty Islands. The partial phase will be visible in Madagascar, the southern part of the Indian Ocean, the extreme southeastern part of Asia, Indonesia, Australia, and the western part of New Zealand.

## ANNULAR ECLIPSE OF 1983 DECEMBER 4

### Central Line

| Ephemeris Time | Latitude | Ephemeris Longitude | Duration | Width of Path | Altitude of Sun |
|---|---|---|---|---|---|
| h m | ° ′ | ° ′ | m s | *mi* | ° |
| Limit | +34 07 | + 58 32 | • •• • | ••• | •• |
| 10 50 | 29 43.1 | 49 08.9 | 3 14.1 | 101 | 9 |
| 55 | 25 10.1 | 40 56.0 | 3 17.8 | 95 | 19 |
| 11 00 | +22 12.4 | + 36 11.1 | 3 20.6 | 91 | 25 |
| 05 | 19 50.5 | 32 38.8 | 3 23.2 | 89 | 30 |
| 10 | 17 49.4 | 29 46.3 | 3 25.6 | 86 | 34 |
| 15 | 16 02.4 | 27 19.1 | 3 27.8 | 85 | 38 |
| 20 | 14 26.2 | 25 09.6 | 3 30.1 | 83 | 41 |
| 25 | 12 58.4 | 23 13.1 | 3 32.3 | 82 | 44 |
| 11 30 | +11 37.5 | + 21 26.5 | 3 34.4 | 81 | 47 |
| 35 | 10 22.6 | 19 47.7 | 3 36.6 | 80 | 50 |
| 40 | 9 12.9 | 18 14.9 | 3 38.7 | 79 | 53 |
| 45 | 8 07.7 | 16 47.0 | 3 40.7 | 79 | 55 |
| 50 | 7 06.8 | 15 22.9 | 3 42.7 | 78 | 57 |
| 55 | 6 09.7 | 14 01.9 | 3 44.7 | 78 | 59 |
| 12 00 | + 5 16.1 | + 12 43.4 | 3 46.5 | 78 | 61 |
| 05 | 4 26.0 | 11 26.6 | 3 48.3 | 78 | 62 |
| 10 | 3 39.0 | 10 11.2 | 3 49.9 | 78 | 64 |
| 15 | 2 55.0 | 8 56.8 | 3 51.5 | 78 | 65 |
| 20 | 2 14.1 | 7 42.8 | 3 52.8 | 79 | 66 |
| 25 | 1 36.1 | 6 29.1 | 3 54.1 | 79 | 66 |
| 12 30 | + 1 00.9 | + 5 15.1 | 3 55.2 | 79 | 66 |
| 35 | + 0 28.5 | 4 00.6 | 3 56.0 | 80 | 66 |
| 40 | − 0 01.0 | 2 45.3 | 3 56.7 | 81 | 66 |
| 45 | 0 27.6 | 1 28.8 | 3 57.2 | 81 | 65 |
| 50 | 0 51.4 | + 0 10.8 | 3 57.4 | 82 | 64 |
| 55 | 1 12.1 | − 1 09.1 | 3 57.4 | 82 | 63 |
| 13 00 | − 1 29.8 | − 2 31.3 | 3 57.1 | 82 | 62 |
| 05 | 1 44.3 | 3 56.2 | 3 56.6 | 83 | 60 |
| 10 | 1 55.4 | 5 24.2 | 3 55.8 | 84 | 58 |
| 15 | 2 03.0 | 6 56.0 | 3 54.8 | 85 | 56 |
| 20 | 2 06.7 | 8 32.3 | 3 53.5 | 86 | 54 |
| 25 | 2 06.3 | 10 13.7 | 3 51.9 | 86 | 51 |
| 13 30 | − 2 01.3 | − 12 01.3 | 3 50.1 | 87 | 49 |
| 35 | 1 51.2 | 13 56.4 | 3 48.1 | 88 | 46 |
| 40 | 1 35.2 | 16 00.6 | 3 45.8 | 89 | 43 |
| 45 | 1 12.4 | 18 16.4 | 3 43.3 | 90 | 40 |
| 50 | − 0 41.1 | 20 47.0 | 3 40.5 | 92 | 36 |
| 55 | + 0 00.9 | 23 37.8 | 3 37.4 | 94 | 32 |
| 14 00 | + 0 57.4 | − 26 57.7 | 3 34.0 | 95 | 28 |
| 05 | 2 16.6 | 31 05.3 | 3 30.1 | 98 | 22 |
| 10 | 4 20.1 | 36 51.9 | 3 25.3 | 102 | 15 |
| Limit | + 9 33 | − 50 01 | • •• • | ••• | •• |

Geocentric conjunction will occur in right ascension $16^h\ 41^m\ 01\overset{s}{.}56$, at E. T. $4^d\ 12^h\ 20^m\ 26\overset{s}{.}8$, the declination of the Sun being $-22°\ 12'\ 04\overset{''}{.}1$.

The path of the annular phase will begin in the Atlantic Ocean northeast of the Bermuda Islands, will pass south of the Cape Verde Islands, will enter Africa just south of the equator, and will end at the extreme northeastern part of Africa. The partial phase will be visible in extreme northeastern North America, the northeastern part of South America, the Atlantic Ocean, the British Isles, Iceland, southern Europe, Africa, southwestern Asia, and the western part of the Indian Ocean.

## ANNULAR ECLIPSE OF 1984 MAY 30

### Central Line

| Ephemeris Time | Latitude | Ephemeris Longitude | Duration | Width of Path | Altitude of Sun |
|---|---|---|---|---|---|
| h m | ° ′ | ° ′ | m s | *mi* | ° |
| Limit | + 1 31 | +135 49 | • •• • | ••• | •• |
| 15 00 | 5 18.3 | 127 21.3 | 0 55.9 | 37 | 10 |
| 05 | 9 29.4 | 119 36.9 | 0 49.0 | 30 | 19 |
| 10 | 12 20.3 | 115 00.4 | 0 44.1 | 26 | 26 |
| 15 | 14 41.3 | 111 29.4 | 0 40.1 | 23 | 31 |
| 20 | 16 44.9 | 108 34.1 | 0 36.4 | 20 | 35 |
| 25 | 18 36.7 | 106 01.3 | 0 33.2 | 17 | 39 |
| 15 30 | +20 19.6 | +103 44.1 | 0 30.2 | 16 | 43 |
| 35 | 21 55.5 | 101 37.9 | 0 27.4 | 13 | 46 |
| 40 | 23 25.5 | 99 39.9 | 0 24.8 | 12 | 49 |
| 45 | 24 50.5 | 97 48.0 | 0 22.4 | 10 | 52 |
| 50 | 26 11.2 | 96 00.6 | 0 20.2 | 10 | 55 |
| 55 | 27 27.9 | 94 16.5 | 0 18.2 | 8 | 58 |
| 16 00 | +28 41.0 | + 92 34.6 | 0 16.3 | 7 | 60 |
| 05 | 29 50.8 | 90 54.1 | 0 14.6 | 6 | 63 |
| 10 | 30 57.5 | 89 14.4 | 0 13.0 | 6 | 65 |
| 15 | 32 01.1 | 87 34.9 | 0 11.7 | 5 | 67 |
| 20 | 33 01.8 | 85 54.9 | 0 10.5 | 4 | 69 |
| 25 | 33 59.7 | 84 14.0 | 0 09.4 | 4 | 71 |
| 16 30 | +34 54.8 | + 82 31.7 | 0 08.6 | 3 | 72 |
| 35 | 35 47.0 | 80 47.7 | 0 07.9 | 3 | 73 |
| 40 | 36 36.4 | 79 01.5 | 0 07.4 | 3 | 74 |
| 45 | 37 22.9 | 77 12.7 | 0 07.1 | 3 | 74 |
| 50 | 38 06.5 | 75 21.0 | 0 07.0 | 2 | 74 |
| 55 | 38 47.1 | 73 26.0 | 0 07.1 | 2 | 73 |
| 17 00 | +39 24.6 | + 71 27.5 | 0 07.3 | 3 | 72 |
| 05 | 39 58.7 | 69 24.9 | 0 07.8 | 3 | 71 |
| 10 | 40 29.5 | 67 18.0 | 0 08.4 | 3 | 69 |
| 15 | 40 56.6 | 65 06.4 | 0 09.2 | 4 | 68 |
| 20 | 41 19.8 | 62 49.7 | 0 10.2 | 4 | 66 |
| 25 | 41 39.0 | 60 27.5 | 0 11.4 | 5 | 63 |
| 17 30 | +41 53.8 | + 57 59.3 | 0 12.8 | 6 | 61 |
| 35 | 42 03.8 | 55 24.6 | 0 14.4 | 6 | 59 |
| 40 | 42 08.7 | 52 42.8 | 0 16.2 | 7 | 56 |
| 45 | 42 07.9 | 49 53.1 | 0 18.1 | 8 | 53 |
| 50 | 42 00.8 | 46 54.5 | 0 20.3 | 9 | 50 |
| 55 | 41 46.7 | 43 45.8 | 0 22.6 | 10 | 47 |
| 18 00 | +41 24.6 | + 40 25.1 | 0 25.2 | 12 | 44 |
| 05 | 40 53.0 | 36 50.1 | 0 27.9 | 13 | 40 |
| 10 | 40 10.0 | 32 56.6 | 0 31.0 | 16 | 36 |
| 15 | 39 12.5 | 28 38.5 | 0 34.3 | 18 | 32 |
| 20 | 37 55.2 | 23 44.1 | 0 38.1 | 21 | 27 |
| 25 | 36 06.7 | 17 48.2 | 0 42.5 | 25 | 21 |
| 18 30 | +33 11.0 | + 9 26.8 | 0 48.5 | 30 | 13 |
| Limit | +28 03 | − 3 31 | • •• • | ••• | •• |

Geocentric conjunction will occur in right ascension $4^h\ 31^m\ 03\overset{s}{.}47$, at E. T. $30^d\ 16^h\ 53^m\ 32\overset{s}{.}2$, the declination of the Sun being +21° 52′ 08″.4.

The path of the annular phase will begin in the Pacific Ocean near the equator at longitude +140°, will cross central Mexico, the southeastern part of the United States, and the Azores, and will end in northwestern Africa. The partial phase will be visible in the eastern part of the Pacific Ocean, North America except the northwestern part, the arctic regions, Greenland, Iceland, the extreme northwestern part of South America, western Africa, the North Atlantic Ocean, and most of Europe.

## TOTAL ECLIPSE OF 1984 NOVEMBER 22 – 23

### Central Line

| Ephemeris Time h m | Latitude ° ′ | Ephemeris Longitude ° ′ | Duration m s | Width of Path *mi* | Altitude of Sun ° |
|---|---|---|---|---|---|
| Limit | − 0 35 | −127 55 | • •• • | ••• | •• |
| 21 15 | 3 45.0 | 135 33.2 | 0 34.7 | 26 | 9 |
| 20 | 8 10.2 | 144 08.4 | 0 48.7 | 34 | 19 |
| 25 | 11 07.7 | 149 00.1 | 0 58.0 | 39 | 26 |
| 21 30 | −13 35.2 | −152 39.7 | 1 05.7 | 42 | 31 |
| 35 | 15 45.5 | 155 41.1 | 1 12.3 | 45 | 36 |
| 40 | 17 44.2 | 158 18.4 | 1 18.3 | 47 | 40 |
| 45 | 19 34.4 | 160 39.3 | 1 23.7 | 48 | 43 |
| 50 | 21 17.8 | 162 48.6 | 1 28.7 | 50 | 47 |
| 55 | 22 55.6 | 164 49.5 | 1 33.2 | 51 | 50 |
| 22 00 | −24 28.7 | −166 44.1 | 1 37.3 | 52 | 53 |
| 05 | 25 57.6 | 168 34.2 | 1 41.1 | 53 | 56 |
| 10 | 27 22.8 | 170 21.2 | 1 44.5 | 53 | 58 |
| 15 | 28 44.7 | 172 06.2 | 1 47.6 | 54 | 61 |
| 20 | 30 03.4 | 173 50.0 | 1 50.3 | 54 | 63 |
| 25 | 31 19.2 | 175 33.6 | 1 52.7 | 55 | 65 |
| 22 30 | −32 32.2 | −177 17.7 | 1 54.7 | 55 | 67 |
| 35 | 33 42.5 | −179 02.8 | 1 56.4 | 55 | 69 |
| 40 | 34 50.1 | +179 10.4 | 1 57.8 | 55 | 70 |
| 45 | 35 55.0 | 177 21.3 | 1 58.7 | 55 | 71 |
| 50 | 36 57.2 | 175 29.3 | 1 59.3 | 55 | 72 |
| 55 | 37 56.6 | 173 33.9 | 1 59.5 | 55 | 72 |
| 23 00 | −38 53.2 | +171 34.5 | 1 59.4 | 54 | 71 |
| 05 | 39 46.9 | 169 30.5 | 1 58.8 | 54 | 71 |
| 10 | 40 37.5 | 167 21.5 | 1 57.9 | 53 | 70 |
| 15 | 41 24.8 | 165 06.8 | 1 56.5 | 53 | 68 |
| 20 | 42 08.6 | 162 45.8 | 1 54.8 | 52 | 67 |
| 25 | 42 48.7 | 160 17.9 | 1 52.7 | 52 | 65 |
| 23 30 | −43 24.6 | +157 42.3 | 1 50.1 | 51 | 62 |
| 35 | 43 56.1 | 154 58.5 | 1 47.2 | 50 | 60 |
| 40 | 44 22.7 | 152 05.4 | 1 43.8 | 49 | 58 |
| 45 | 44 43.8 | 149 02.2 | 1 40.1 | 48 | 55 |
| 50 | 44 58.9 | 145 47.8 | 1 35.9 | 48 | 52 |
| 55 | 45 07.0 | 142 20.8 | 1 31.2 | 46 | 49 |
| 0 00 | −45 07.1 | +138 39.3 | 1 26.2 | 44 | 46 |
| 05 | 44 58.0 | 134 41.0 | 1 20.7 | 43 | 42 |
| 10 | 44 37.6 | 130 22.2 | 1 14.6 | 41 | 38 |
| 15 | 44 03.3 | 125 37.3 | 1 07.9 | 39 | 34 |
| 20 | 43 10.4 | 120 16.3 | 1 00.5 | 36 | 30 |
| 25 | 41 50.2 | 113 59.1 | 0 51.9 | 33 | 24 |
| 0 30 | −39 39.7 | +105 50.2 | 0 41.3 | 29 | 17 |
| Limit | −33 29 | + 87 53 | • •• • | ••• | •• |

Geocentric conjunction will occur in right ascension $15^h\ 54^m\ 45\overset{s}{.}84$, at E. T. $22^d\ 23^h\ 04^m\ 45\overset{s}{.}8$, the declination of the Sun being $-20°\ 19'\ 42\overset{''}{.}6$.

The path of the total phase will begin west of New Guinea, will cross New Guinea, will pass south of New Caledonia and northeast of New Zealand, and will end in the eastern South Pacific Ocean off the coast of Chile. The partial phase will be visible in Indonesia, Australia, the southern part of the Philippine Islands, part of Antarctica, New Zealand, the South Pacific Ocean, and the southern tip of South America.

## PARTIAL ECLIPSE OF 1985 MAY 19

Geocentric conjunction will occur in right ascension $3^h\ 46^m\ 30^s.75$, at E. T. $19^d\ 22^h\ 11^m\ 11^s.5$, the declination of the Sun being $+19°\ 54'\ 24''.5$. The greatest eclipse will have a magnitude of 0.841 at longitude $-80°\ 40'$, latitude $+63°\ 18'$.

The eclipse will be visible in northeastern Asia, Japan, northern North America, Greenland, Iceland, extreme northwestern Europe, the arctic regions, and the North Pacific Ocean.

## TOTAL ECLIPSE OF 1985 NOVEMBER 12

Central Line

| Ephemeris Time h m | Latitude ° ′ | Ephemeris Longitude ° ′ | Duration m s | Width of Path *mi* | Altitude of Sun ° |
|---|---|---|---|---|---|
| Limit | −53 58 | +148 06 | • •• • | ••• | •• |
| 13 55 | 58 11.6 | 141 06.0 | 1 50.3 | 494 | 6 |
| 14 00 | −61 53.3 | +139 06.7 | 1 55.2 | 481 | 9 |
| 05 | 64 59.7 | 139 34.3 | 1 57.6 | 461 | 10 |
| 10 | 67 47.5 | 141 58.5 | 1 58.5 | 444 | 11 |
| 15 | 70 17.4 | 146 40.8 | 1 58.2 | 433 | 11 |
| 20 | 72 19.9 | 154 34.0 | 1 56.6 | 428 | 10 |
| 25 | 73 25.8 | +166 58.4 | 1 53.1 | 433 | 7 |
| 14 30 | −71 21.9 | −173 32.1 | 1 44.8 | 457 | 2 |
| Limit | −69 31 | −169 15 | • •• • | ••• | •• |

Geocentric conjunction will occur in right ascension $15^h\ 10^m\ 53^s.21$, at E. T. $12^d\ 14^h\ 50^m\ 15^s.4$, the declination of the Sun being $-17°\ 47'\ 17''.7$.

The central eclipse will begin and will end at sunrise. The path of the total phase will begin in the South Pacific Ocean, will cross the Ross Sea, and will end between Cape Adare, Antarctica and Scott Island in the South Pacific Ocean. The partial phase will be visible in most of Antarctica, the eastern part of the South Pacific Ocean, the southern part of South America, and the southwestern part of the South Atlantic Ocean.

## PARTIAL ECLIPSE OF 1986 APRIL 9

Geocentric conjunction will occur in right ascension $1^h\ 10^m\ 21\overset{s}{.}85$, at E. T. $9^d\ 05^h\ 14^m\ 48\overset{s}{.}7$, the declination of the Sun being +7° 27′ 58″.6. The greatest eclipse will have a magnitude 0.824 at longitude −161° 10′, latitude −61° 22′.

The eclipse will be visible in part of Indonesia, Australia, New Guinea, South Island of New Zealand, part of Antarctica, and the southern part of the Indian Ocean.

## ANNULAR – TOTAL ECLIPSE OF 1986 OCTOBER 3

Central Line

| Ephemeris Time | Latitude | Ephemeris Longitude | Duration | Width of Path | Altitude of Sun |
|---|---|---|---|---|---|
| h m | ° ′ | ° ′ | m s | *mi* | ° |
| Limit | +66 27 | + 26 10 | • •• • | ••• | •• |
| 18 57 | 65 30.7 | 31 27.8 | 0 00.8 | 5 | 2 |
| 58 | 64 45.0 | 33 31.5 | 0 02.6 | 2 | 3 |
| 59 | 64 03.4 | 34 50.9 | 0 01.9 | 6 | 4 |
| 19 00 | +63 24.4 | + 35 47.0 | 0 01.3 | 9 | 4 |
| 01 | 62 47.2 | 36 27.7 | 0 00.8 | 11 | 5 |
| 02 | 62 11.6 | 36 57.1 | 0 00.5 | 13 | 5 |
| 03 | 61 37.2 | 37 17.7 | 0 00.2 | 14 | 5 |
| 04 | 61 04.1 | 37 30.9 | 0 00.0 | 16 | 5 |
| 19 05 | +60 31.9 | + 37 37.7 | 0 00.2 | 17 | 5 |
| 06 | 60 00.8 | 37 38.8 | 0 00.2 | 17 | 6 |
| 07 | 59 30.5 | 37 34.6 | 0 00.3 | 18 | 6 |
| 08 | 59 01.2 | 37 25.3 | 0 00.2 | 18 | 5 |
| 09 | 58 32.6 | 37 10.9 | 0 00.1 | 18 | 5 |
| 19 10 | +58 04.9 | + 36 51.3 | 0 00.0 | 17 | 5 |
| 11 | 57 38.1 | 36 26.0 | 0 00.2 | 17 | 5 |
| 12 | 57 12.1 | 35 54.3 | 0 00.5 | 15 | 5 |
| 13 | 56 47.0 | 35 14.8 | 0 00.9 | 13 | 4 |
| 14 | 56 23.1 | 34 25.1 | 0 01.4 | 10 | 4 |
| 19 15 | +56 00.6 | + 33 20.5 | 0 02.1 | 5 | 3 |
| 16 | 55 40.5 | 31 47.6 | 0 00.3 | 2 | 2 |
| Limit | +55 33 | + 27 56 | • •• • | ••• | •• |

Geocentric conjunction will occur in right ascension $12^h\ 37^m\ 36\overset{s}{.}86$, at E. T. $3^d\ 18^h\ 07^m\ 20\overset{s}{.}9$, the declination of the Sun being −4° 03′ 09″.5.

The central eclipse will begin and will end at sunset. The path of the annular–total phase will begin between Greenland and Iceland, and will end to the south of Iceland. The partial phase will be visible in North America except the extreme southwestern part, the extreme northeastern part of Asia, most of the North Atlantic Ocean, Iceland, Greenland, northern South America, and the artic regions.

## ANNULAR – TOTAL ECLIPSE OF 1987 MARCH 29

Central Line

| Ephemeris Time | Latitude | Ephemeris Longitude | Duration | Width of Path | Altitude of Sun |
|---|---|---|---|---|---|
| h m | ° ′ | ° ′ | m s | *mi* | ° |
| Limit | -46 48 | + 71 42 | • •• • | ••• | •• |
| 11 10 | 43 58.6 | 50 38.4 | 0 35.4 | 19 | 16 |
| 15 | 41 42.4 | 42 10.7 | 0 28.6 | 15 | 23 |
| 20 | 39 39.4 | 36 26.3 | 0 23.3 | 11 | 29 |
| 25 | 37 44.3 | 32 02.0 | 0 18.7 | 9 | 34 |
| 11 30 | -35 54.9 | + 28 26.9 | 0 14.7 | 7 | 38 |
| 35 | 34 09.9 | 25 25.7 | 0 11.0 | 5 | 41 |
| 40 | 32 28.5 | 22 49.3 | 0 07.7 | 3 | 45 |
| 45 | 30 50.2 | 20 31.7 | 0 04.7 | 2 | 48 |
| 50 | 29 14.5 | 18 28.9 | 0 02.0 | 1 | 51 |
| 55 | 27 41.2 | 16 38.0 | 0 03.6 | 0 | 54 |
| 12 00 | -26 09.9 | + 14 56.8 | 0 01.4 | 1 | 57 |
| 05 | 24 40.5 | 13 23.4 | 0 00.5 | 2 | 59 |
| 10 | 23 12.8 | 11 56.5 | 0 02.2 | 2 | 62 |
| 15 | 21 46.6 | 10 35.0 | 0 03.6 | 3 | 64 |
| 20 | 20 21.8 | 9 17.9 | 0 04.8 | 4 | 66 |
| 25 | 18 58.3 | 8 04.4 | 0 05.8 | 4 | 68 |
| 12 30 | -17 35.9 | + 6 53.9 | 0 06.6 | 4 | 69 |
| 35 | 16 14.7 | 5 45.5 | 0 07.2 | 5 | 70 |
| 40 | 14 54.4 | 4 38.9 | 0 07.5 | 5 | 71 |
| 45 | 13 35.1 | 3 33.4 | 0 07.6 | 5 | 72 |
| 50 | 12 16.7 | 2 28.6 | 0 07.6 | 5 | 72 |
| 55 | 10 59.1 | 1 24.0 | 0 07.2 | 5 | 72 |
| 13 00 | - 9 42.2 | + 0 19.2 | 0 06.7 | 5 | 71 |
| 05 | 8 26.1 | - 0 46.5 | 0 05.9 | 4 | 70 |
| 10 | 7 10.7 | 1 53.3 | 0 05.0 | 4 | 69 |
| 15 | 5 56.0 | 3 01.9 | 0 03.8 | 3 | 68 |
| 20 | 4 41.9 | 4 12.7 | 0 02.4 | 3 | 66 |
| 25 | 3 28.5 | 5 26.4 | 0 00.8 | 2 | 64 |
| 13 30 | - 2 15.7 | - 6 43.6 | 0 01.0 | 2 | 61 |
| 35 | - 1 03.5 | 8 05.0 | 0 03.1 | 1 | 59 |
| 40 | + 0 08.1 | 9 31.5 | 0 01.3 | 1 | 57 |
| 45 | 1 19.0 | 11 04.3 | 0 03.9 | 2 | 54 |
| 50 | 2 29.2 | 12 44.4 | 0 06.7 | 3 | 51 |
| 55 | 3 38.7 | 14 33.6 | 0 09.7 | 5 | 48 |
| 14 00 | + 4 47.4 | - 16 34.0 | 0 13.0 | 6 | 45 |
| 05 | 5 55.0 | 18 48.4 | 0 16.6 | 8 | 41 |
| 10 | 7 01.4 | 21 21.0 | 0 20.5 | 10 | 37 |
| 15 | 8 06.3 | 24 18.1 | 0 24.8 | 13 | 33 |
| 20 | 9 08.9 | 27 50.5 | 0 29.5 | 15 | 29 |
| 25 | 10 08.1 | 32 20.0 | 0 34.9 | 19 | 23 |
| 14 30 | +11 00.2 | - 38 47.4 | 0 41.7 | 24 | 15 |
| Limit | +11 10 | - 53 22 | • •• • | ••• | •• |

Geocentric conjunction will occur in right ascension $0^h\ 30^m\ 26^s.69$, at E. T. $29^d\ 12^h\ 31^m\ 18^s.8$, the declination of the Sun being $+3°\ 17'\ 14''.0$.

The path of the annular–total phase will begin in southern South America, will cross the South Atlantic Ocean, will enter Africa near the equator, and will end in the Indian Ocean off the northeast coast of Africa. The partial phase will be visible in the southeastern part of South America, part of Antarctica, the South Atlantic Ocean, Africa except the extreme northwestern part, extreme southeastern Europe, extreme southwestern Asia, and the western part of the Indian Ocean.

## ANNULAR ECLIPSE OF 1987 SEPTEMBER 23

### Central Line

| Ephemeris Time | Latitude | Ephemeris Longitude | Duration | Width of Path | Altitude of Sun |
|---|---|---|---|---|---|
| h m | ° ′ | ° ′ | m s | *mi* | ° |
| Limit | +45 34 | − 67 27 | • •• • | ••• | •• |
| 1 25 | 44 36.9 | 84 38.7 | 3 29.5 | 112 | 13 |
| 1 30 | +42 58.0 | − 94 38.1 | 3 33.2 | 106 | 21 |
| 35 | 41 21.0 | 101 03.5 | 3 35.8 | 102 | 27 |
| 40 | 39 46.0 | 105 54.7 | 3 37.7 | 99 | 32 |
| 45 | 38 12.8 | 109 49.8 | 3 39.3 | 97 | 36 |
| 50 | 36 41.5 | 113 06.7 | 3 40.6 | 94 | 40 |
| 55 | 35 11.8 | 115 55.8 | 3 41.6 | 93 | 43 |
| 2 00 | +33 43.6 | −118 23.6 | 3 42.5 | 91 | 46 |
| 05 | 32 16.8 | 120 34.7 | 3 43.2 | 90 | 49 |
| 10 | 30 51.3 | 122 32.3 | 3 43.7 | 88 | 52 |
| 15 | 29 27.0 | 124 18.8 | 3 44.2 | 87 | 55 |
| 20 | 28 03.8 | 125 56.2 | 3 44.5 | 86 | 58 |
| 25 | 26 41.6 | 127 25.9 | 3 44.8 | 86 | 60 |
| 2 30 | +25 20.2 | −128 49.2 | 3 45.0 | 85 | 62 |
| 35 | 23 59.8 | 130 07.0 | 3 45.1 | 84 | 65 |
| 40 | 22 40.1 | 131 20.4 | 3 45.1 | 84 | 67 |
| 45 | 21 21.2 | 132 29.9 | 3 45.1 | 83 | 68 |
| 50 | 20 02.9 | 133 36.2 | 3 45.1 | 83 | 70 |
| 55 | 18 45.2 | 134 40.0 | 3 45.0 | 83 | 71 |
| 3 00 | +17 28.1 | −135 41.7 | 3 44.9 | 83 | 73 |
| 05 | 16 11.5 | 136 41.8 | 3 44.8 | 83 | 73 |
| 10 | 14 55.3 | 137 40.8 | 3 44.6 | 83 | 74 |
| 15 | 13 39.6 | 138 39.1 | 3 44.4 | 84 | 74 |
| 20 | 12 24.2 | 139 37.0 | 3 44.2 | 84 | 73 |
| 25 | 11 09.2 | 140 35.2 | 3 44.0 | 85 | 73 |
| 3 30 | + 9 54.4 | −141 33.8 | 3 43.7 | 86 | 71 |
| 35 | 8 40.0 | 142 33.4 | 3 43.4 | 86 | 70 |
| 40 | 7 25.7 | 143 34.4 | 3 43.1 | 87 | 68 |
| 45 | 6 11.6 | 144 37.2 | 3 42.8 | 88 | 67 |
| 50 | 4 57.7 | 145 42.4 | 3 42.4 | 89 | 65 |
| 55 | 3 43.9 | 146 50.6 | 3 42.0 | 90 | 62 |
| 4 00 | + 2 30.2 | −148 02.4 | 3 41.4 | 91 | 60 |
| 05 | 1 16.5 | 149 18.5 | 3 40.9 | 92 | 58 |
| 10 | + 0 02.8 | 150 39.9 | 3 40.2 | 94 | 55 |
| 15 | − 1 10.9 | 152 07.5 | 3 39.5 | 95 | 52 |
| 20 | 2 24.7 | 153 42.7 | 3 38.7 | 97 | 49 |
| 25 | 3 38.5 | 155 27.2 | 3 37.8 | 97 | 46 |
| 4 30 | − 4 52.5 | −157 23.3 | 3 36.7 | 99 | 43 |
| 35 | 6 06.7 | 159 33.9 | 3 35.5 | 101 | 40 |
| 40 | 7 21.1 | 162 03.8 | 3 34.0 | 102 | 36 |
| 45 | 8 35.8 | 164 59.9 | 3 32.3 | 105 | 31 |
| 50 | 9 50.8 | 168 34.9 | 3 30.3 | 106 | 27 |
| 55 | 11 06.3 | −173 15.9 | 3 27.7 | 109 | 21 |
| 5 00 | −12 22.4 | +179 27.9 | 3 24.1 | 113 | 12 |
| Limit | −13 06 | +167 34 | • •• • | ••• | •• |

Geocentric conjunction will occur in right ascension $11^h\ 58^m\ 22\overset{s}{.}40$, at E. T. $23^d\ 02^h\ 54^m\ 27\overset{s}{.}0$, the declination of the Sun being +0° 10′ 34″.8.

The path of the annular phase will begin in west central Asia, will cross China and Okinawa, will pass between Micronesia and Melanesia, and will end near the Samoa Islands. The partial phase will be visible in Asia except the northeastern and southwestern parts, the northeastern half of Australia, the western part of the Pacific Ocean, and Oceania.

## TOTAL ECLIPSE OF 1988 MARCH 17 – 18

### Central Line

| Ephemeris Time | Latitude | Ephemeris Longitude | Duration | Width of Path | Altitude of Sun |
|---|---|---|---|---|---|
| h m | ° ′ | ° ′ | m s | *mi* | ° |
| Limit | − 4 22 | − 85 51 | • •• • | ••• | •• |
| 0 25 | 4 18.4 | 91 24.2 | 1 50.3 | 76 | 6 |
| 0 30 | − 3 09.2 | −102 23.4 | 2 14.1 | 87 | 18 |
| 35 | 1 54.6 | 107 55.8 | 2 28.3 | 93 | 25 |
| 40 | − 0 38.3 | 111 59.1 | 2 39.7 | 97 | 30 |
| 45 | + 0 38.8 | 115 15.0 | 2 49.4 | 101 | 34 |
| 50 | 1 56.6 | 118 00.6 | 2 57.9 | 103 | 38 |
| 55 | 3 14.9 | 120 24.9 | 3 05.5 | 105 | 42 |
| 1 00 | + 4 33.7 | −122 33.3 | 3 12.2 | 107 | 45 |
| 05 | 5 52.9 | 124 29.5 | 3 18.2 | 109 | 48 |
| 10 | 7 12.5 | 126 16.1 | 3 23.6 | 109 | 51 |
| 15 | 8 32.7 | 127 54.9 | 3 28.3 | 109 | 54 |
| 20 | 9 53.3 | 129 27.5 | 3 32.4 | 110 | 56 |
| 25 | 11 14.4 | 130 55.1 | 3 36.0 | 110 | 58 |
| 1 30 | +12 36.1 | −132 18.7 | 3 39.0 | 109 | 60 |
| 35 | 13 58.4 | 133 39.3 | 3 41.5 | 109 | 61 |
| 40 | 15 21.4 | 134 57.5 | 3 43.5 | 109 | 63 |
| 45 | 16 45.0 | 136 14.0 | 3 45.0 | 109 | 64 |
| 50 | 18 09.4 | 137 29.7 | 3 45.9 | 108 | 65 |
| 55 | 19 34.7 | 138 45.0 | 3 46.4 | 107 | 65 |
| 2 00 | +21 00.8 | −140 00.6 | 3 46.4 | 106 | 65 |
| 05 | 22 27.9 | 141 17.2 | 3 45.9 | 105 | 65 |
| 10 | 23 56.1 | 142 35.4 | 3 44.9 | 105 | 64 |
| 15 | 25 25.4 | 143 55.9 | 3 43.4 | 104 | 63 |
| 20 | 26 56.0 | 145 19.6 | 3 41.5 | 103 | 62 |
| 25 | 28 28.0 | 146 47.3 | 3 39.0 | 102 | 61 |
| 2 30 | +30 01.4 | −148 19.9 | 3 36.0 | 101 | 59 |
| 35 | 31 36.6 | 149 58.8 | 3 32.5 | 100 | 57 |
| 40 | 33 13.5 | 151 45.3 | 3 28.5 | 98 | 55 |
| 45 | 34 52.5 | 153 41.1 | 3 23.9 | 97 | 52 |
| 50 | 36 33.8 | 155 48.6 | 3 18.7 | 96 | 50 |
| 55 | 38 17.6 | 158 10.4 | 3 12.9 | 94 | 47 |
| 3 00 | +40 04.2 | −160 50.6 | 3 06.4 | 94 | 44 |
| 05 | 41 54.0 | 163 54.3 | 2 59.2 | 91 | 40 |
| 10 | 43 47.6 | 167 29.6 | 2 51.2 | 90 | 37 |
| 15 | 45 45.6 | 171 48.8 | 2 42.1 | 87 | 32 |
| 20 | 47 48.8 | −177 13.7 | 2 31.6 | 85 | 28 |
| 25 | 49 58.7 | +175 30.5 | 2 19.2 | 82 | 22 |
| 3 30 | +52 18.5 | +164 05.4 | 2 02.5 | 78 | 13 |
| Limit | +54 04 | +142 30 | • •• • | ••• | •• |

Geocentric conjunction will occur in right ascension $23^h\ 51^m\ 35\overset{s}{.}67$, at E. T. $18^d\ 02^h\ 23^m\ 09\overset{s}{.}5$, the declination of the Sun being $-0°\ 54'\ 39\overset{''}{.}2$.

The path of the total phase will begin in the Indian Ocean west of Sumatra, will cross Indonesia and the southern part of the Philippine Islands, will pass near the Mariana Islands and south of the Aleutian Islands, and will end in the Gulf of Alaska. The partial phase will be visible in eastern Asia, Indonesia, Micronesia, northwestern Australia, the northeastern part of the Indian Ocean, extreme northwestern North America, the western Hawaiian Islands, and the North Pacific Ocean.

## ANNULAR ECLIPSE OF 1988 SEPTEMBER 11

### Central Line

| Ephemeris Time | Latitude | Ephemeris Longitude | Duration | Width of Path | Altitude of Sun |
|---|---|---|---|---|---|
| h m | ° ′ | ° ′ | m s | *mi* | ° |
| Limit | + 0 51 | − 44 14 | • •• • | ••• | •• |
| 3 00 | 1 07.9 | 49 12.1 | 5 27.5 | 193 | 5 |
| 05 | 0 50.8 | 59 20.6 | 5 46.0 | 190 | 16 |
| 10 | + 0 08.8 | 64 24.9 | 5 56.8 | 189 | 23 |
| 15 | − 0 40.2 | 68 07.0 | 6 05.4 | 189 | 28 |
| 20 | 1 33.2 | 71 05.3 | 6 12.5 | 188 | 32 |
| 25 | 2 28.8 | 73 35.4 | 6 18.7 | 186 | 35 |
| 3 30 | − 3 26.5 | − 75 45.7 | 6 24.2 | 185 | 39 |
| 35 | 4 25.8 | 77 40.9 | 6 28.9 | 184 | 41 |
| 40 | 5 26.5 | 79 24.5 | 6 33.1 | 182 | 44 |
| 45 | 6 28.5 | 80 58.7 | 6 36.8 | 181 | 47 |
| 50 | 7 31.5 | 82 25.3 | 6 40.0 | 179 | 49 |
| 55 | 8 35.6 | 83 45.6 | 6 42.8 | 177 | 51 |
| 4 00 | − 9 40.6 | − 85 00.8 | 6 45.1 | 174 | 53 |
| 05 | 10 46.6 | 86 11.6 | 6 47.1 | 173 | 55 |
| 10 | 11 53.6 | 87 18.8 | 6 48.8 | 170 | 57 |
| 15 | 13 01.5 | 88 23.1 | 6 50.1 | 169 | 58 |
| 20 | 14 10.3 | 89 25.1 | 6 51.1 | 166 | 59 |
| 25 | 15 20.1 | 90 25.2 | 6 51.8 | 165 | 60 |
| 4 30 | −16 30.9 | − 91 23.9 | 6 52.2 | 162 | 61 |
| 35 | 17 42.7 | 92 21.6 | 6 52.4 | 161 | 62 |
| 40 | 18 55.6 | 93 18.9 | 6 52.3 | 159 | 62 |
| 45 | 20 09.5 | 94 16.1 | 6 52.0 | 159 | 62 |
| 50 | 21 24.6 | 95 13.7 | 6 51.4 | 157 | 62 |
| 55 | 22 41.0 | 96 12.0 | 6 50.6 | 156 | 61 |
| 5 00 | −23 58.7 | − 97 11.7 | 6 49.6 | 155 | 61 |
| 05 | 25 17.7 | 98 13.1 | 6 48.3 | 155 | 60 |
| 10 | 26 38.3 | 99 16.9 | 6 46.8 | 154 | 59 |
| 15 | 28 00.4 | 100 23.7 | 6 45.0 | 154 | 58 |
| 20 | 29 24.3 | 101 34.2 | 6 43.1 | 153 | 56 |
| 25 | 30 50.2 | 102 49.1 | 6 40.9 | 153 | 54 |
| 5 30 | −32 18.1 | −104 09.5 | 6 38.4 | 154 | 53 |
| 35 | 33 48.3 | 105 36.5 | 6 35.6 | 154 | 51 |
| 40 | 35 21.1 | 107 11.7 | 6 32.5 | 155 | 48 |
| 45 | 36 56.8 | 108 56.8 | 6 29.1 | 155 | 46 |
| 50 | 38 35.8 | 110 54.2 | 6 25.4 | 156 | 43 |
| 55 | 40 18.6 | 113 07.2 | 6 21.1 | 158 | 41 |
| 6 00 | −42 05.9 | −115 40.2 | 6 16.5 | 159 | 38 |
| 05 | 43 58.5 | 118 39.8 | 6 11.3 | 162 | 34 |
| 10 | 45 57.7 | 122 16.2 | 6 05.4 | 164 | 31 |
| 15 | 48 05.6 | 126 47.5 | 5 58.7 | 167 | 26 |
| 20 | 50 26.0 | 132 49.6 | 5 50.5 | 172 | 21 |
| 25 | 53 08.1 | 142 03.6 | 5 39.8 | 178 | 14 |
| Limit | −56 42 | −165 03 | • •• • | ••• | •• |

Geocentric conjunction will occur in right ascension $11^h\ 18^m\ 23^s.91$, at E. T. $11^d\ 05^h\ 15^m\ 01^s.0$, the declination of the Sun being +4° 28′ 33″.8.

The path of the annular phase will begin at the coast of the Somali Republic in Africa, will cross the Indian Ocean, will pass south of Australia, and will end in the South Pacific Ocean. The partial phase will be visible in extreme eastern Africa, southern Asia, Indonesia, most of Australia, New Zealand, part of Antarctica, and the Indian Ocean.

## PARTIAL ECLIPSE OF 1989 MARCH 7

Geocentric conjunction will occur in right ascension $23^h\ 12^m\ 52^s.72$, at E. T. $7^d\ 19^h\ 09^m\ 58^s.5$, the declination of the Sun being $-5°\ 03'\ 32''.7$. The greatest eclipse will have a magnitude of 0.827 at longitude $+170°\ 04'$, latitude $+61°\ 19'$.

The eclipse will be visible in the Hawaiian Islands, the eastern part of the North Pacific Ocean, the northwestern half of North America, most of Greenland, the extreme northeastern part of Asia, and the arctic regions.

## PARTIAL ECLIPSE OF 1989 AUGUST 31

Geocentric conjunction will occur in right ascension $10^h\ 38^m\ 03^s.69$, at E. T. $31^d\ 06^h\ 44^m\ 00^s.3$, the declination of the Sun being $+8°\ 37'\ 43''.2$. The greatest eclipse will have a magnitude of 0.634 at longitude $-23°\ 22'$, latitude $-61°\ 25'$.

The eclipse will be visible in the extreme southeastern part of Africa, Madagascar, part of Antarctica, and the southern part of the Indian Ocean.

## ANNULAR ECLIPSE OF 1990 JANUARY 26

Central Line

| Ephemeris Time | Latitude | Ephemeris Longitude | Duration | Width of Path | Altitude of Sun |
|---|---|---|---|---|---|
| h m | ° ′ | ° ′ | m s | *mi* | ° |
| Limit | −71 18 | − 73 47 | • •• • | ••• | •• |
| 19 00 | 78 55.3 | 59 48.8 | 2 02.7 | 266 | 8 |
| 05 | 81 11.4 | 34 50.5 | 2 02.0 | 247 | 12 |
| 10 | 80 46.9 | − 11 00.6 | 2 01.5 | 235 | 15 |
| 15 | 79 01.5 | + 4 39.6 | 2 01.0 | 228 | 16 |
| 20 | 76 44.2 | 13 42.6 | 2 00.7 | 224 | 17 |
| 25 | 74 15.6 | 18 53.9 | 2 00.4 | 224 | 18 |
| 19 30 | −71 42.9 | + 21 51.4 | 2 00.1 | 226 | 18 |
| 35 | 69 08.5 | 23 25.8 | 1 60.0 | 230 | 18 |
| 40 | 66 32.3 | 24 03.0 | 1 59.9 | 236 | 18 |
| 45 | 63 53.4 | 23 55.6 | 1 59.9 | 245 | 17 |
| 50 | 61 09.4 | 23 07.5 | 1 59.9 | 255 | 16 |
| 55 | 58 16.5 | 21 34.2 | 2 00.2 | 269 | 14 |
| 20 00 | −55 05.4 | + 18 56.1 | 2 00.6 | 284 | 11 |
| 05 | 51 01.9 | 13 42.8 | 2 01.3 | 298 | 6 |
| Limit | −47 45 | + 6 47 | • •• • | ••• | •• |

Geocentric conjunction will occur in right ascension $20^h\ 35^m\ 48^s.61$, at E. T. $26^d\ 18^h\ 52^m\ 49^s.8$, the declination of the Sun being $-18°\ 38'\ 04''.7$.

The central eclipse will begin and will end at sunset. The path of the annular phase will begin in Princess Elizabeth Land in Antarctica, and will cross Queen Maud Land, and will end in the South Atlantic Ocean. The partial phase will be visible in South Island of New Zealand, most of Antarctica, the eastern part of the South Pacific Ocean, South America except the northwestern part, and the western part of the South Atlantic Ocean.

## TOTAL ECLIPSE OF 1990 JULY 22

Central line

| Ephemeris Time | Latitude | Ephemeris Longitude | Duration | Width of Path | Altitude of Sun |
|---|---|---|---|---|---|
| h m | ° ′ | ° ′ | m s | *mi* | ° |
| Limit | +59 46 | − 23 30 | • •• • | ••• | •• |
| 1 55 | 63 22.4 | 31 21.7 | 1 32.0 | 110 | 5 |
| 2 00 | +69 48.0 | − 49 16.2 | 1 47.8 | 116 | 15 |
| 05 | 72 58.0 | 63 07.5 | 1 57.1 | 118 | 20 |
| 10 | 74 54.5 | 76 57.0 | 2 04.4 | 120 | 24 |
| 15 | 75 57.7 | 90 59.9 | 2 10.3 | 120 | 28 |
| 20 | 76 16.6 | 104 42.9 | 2 15.3 | 121 | 30 |
| 25 | 75 59.3 | 117 21.1 | 2 19.6 | 122 | 33 |
| 2 30 | +75 14.0 | −128 24.4 | 2 23.2 | 123 | 35 |
| 35 | 74 08.4 | 137 46.0 | 2 26.1 | 124 | 36 |
| 40 | 72 48.5 | 145 34.7 | 2 28.5 | 124 | 38 |
| 45 | 71 18.9 | 152 05.9 | 2 30.3 | 125 | 39 |
| 50 | 69 42.4 | 157 35.1 | 2 31.6 | 126 | 40 |
| 55 | 68 01.2 | 162 15.8 | 2 32.4 | 126 | 40 |
| 3 00 | +66 16.5 | −166 18.9 | 2 32.7 | 127 | 40 |
| 05 | 64 29.0 | 169 52.9 | 2 32.5 | 128 | 40 |
| 10 | 62 39.2 | 173 04.6 | 2 31.9 | 128 | 40 |
| 15 | 60 47.3 | 175 59.3 | 2 30.7 | 129 | 40 |
| 20 | 58 53.2 | −178 41.6 | 2 29.1 | 130 | 39 |
| 25 | 56 56.8 | +178 44.9 | 2 27.0 | 131 | 38 |
| 3 30 | +54 57.8 | +176 16.9 | 2 24.4 | 132 | 37 |
| 35 | 52 55.7 | 173 51.0 | 2 21.3 | 132 | 35 |
| 40 | 50 49.8 | 171 23.9 | 2 17.6 | 132 | 33 |
| 45 | 48 39.0 | 168 51.9 | 2 13.4 | 132 | 31 |
| 50 | 46 21.7 | 166 10.1 | 2 08.4 | 132 | 28 |
| 55 | 43 55.4 | 163 11.3 | 2 02.7 | 131 | 25 |
| 4 00 | +41 15.4 | +159 43.3 | 1 56.0 | 128 | 22 |
| 05 | 38 11.7 | 155 19.9 | 1 47.5 | 124 | 17 |
| 10 | 34 07.7 | 148 26.8 | 1 35.4 | 115 | 9 |
| Limit | +29 55 | +139 08 | • •• • | ••• | •• |

Geocentric conjunction will occur in right ascension $8^h\ 04^m\ 47^s.18$, at E. T. $22^d\ 02^h\ 37^m\ 42^s.5$, the declination of the Sun being +20° 21′ 00″.8.

The path of the total phase will begin at the southern coast of Finland, will pass along the northern coasts of Europe and Asia, and will cross the northeastern part of Asia, and will end in the Pacific Ocean between the Hawaiian Islands and North America. The partial phase will be visible in northeastern Europe, northern Greenland, northwestern North America, the northern part of Asia, the Hawaiian Islands, the North Pacific Ocean and the arctic regions.